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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/527,056	10/20/2005	Woo-Seok Cheong	123034-05029639	6957

22429 7590 03/16/2011

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EXAMINER	
FORD, NATHAN K	

ART UNIT	PAPER NUMBER
1712	

MAIL DATE	DELIVERY MODE
03/16/2011	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/527,056	CHEONG ET AL.	
	Examiner	Art Unit	
	NATHAN K. FORD	1712	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 January 2011*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) *1-5* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *6-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Applicant's Response

Acknowledged is the applicant's request for reconsideration filed January 3, 2011. Claims 6 and 11-12 are amended; claims 16-19 are new.

The applicant's arguments are persuasive, and the previous rejections have been withdrawn accordingly. However, upon further search, a new rejection is submitted below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 6-7 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman et al., US 5,730,801, in view of Moon, US 5,660,696, Bottomfield, US 6,506,312, and Holden et al., US 5,911,896.

Claims 6, 16: Tepman teaches the following:

- A first chamber (204) (Fig. 8):
- A second chamber (10b) comprising (Fig. 3):
  - A temperature-adjustable sample holder (64) (8, 25-30);
  - An upper (12) and lower (14) portion (5, 44ff);
  - A middle film (16) dividing the upper from the lower portion (5, 50-55);
  - An elevating portion (49) (7, 65ff);
  - A metal depositing portion for sputtering (1, 15-20; 5, 58-60);
  - A connecting portion (6), i.e., gate valve, connecting the first and second chamber (6, 30-33).

The upper and lower portions are at different pressures when sputtering is executed in the upper chamber.

Tepman does not teach the execution of a cleaning step in the first chamber. In supplementation, Moon attests that it is advantageous to expose a wafer to a halogen lamp in a pre-processing chamber in order to remove any surface moisture prior to sputtering (5, 32-40). Accordingly, it would have been obvious to outfit an available

chamber in the cluster tool of Tepman with a halogen lamp so as to clean the wafer surface before the step of sputtering.

Further, although Tepman teaches a temperature-adjustable sample holder (63) disposed on a substrate holder (62), the reference does not dispose ceramic heating elements therein. Remedying this deficiency is Holden, who disposes ceramic heating elements (37, 38, 40) within a substrate holder to more effectively regulate the temperature of the substrates (3, 4-39). Further, the heating elements are especially configured to provide substantially uniform heating of the substrate (3, 40-43). Given that Tepman independently teaches a need to maintain the substrates within a given temperature range, it would have been obvious to incorporate heating elements within Tepman's sample holder and substrate holder to facilitate substrate heating and temperature control.

The references also omit the feature of a sputter shield. Bottomfield remedies the omission by disclosing a deposition chamber which executes sputtering techniques. Within the chamber a sputter shield (10) is disposed about a susceptor to protect the chamber walls from the excessive contamination which is inevitably produced during the sputtering process (5, 28-33). It would have been obvious to one of ordinary skill in the art to provide a shield to a processing chamber executing the technique of sputtering to protect the chamber walls from corrosive contamination.

Claim 7: The substrate is heated following the onset of deposition (9, 5-15).

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, and Holden as applied to claim 6, and in further view of Tsao, US 4,752,815.

Tepman is silent regarding the growth of an oxide film. Tsao applies an oxide layer which is removed and then regrown to reduce the mechanical stress of the structure (3, 37-40). For this reason, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form an oxide layer in the second chamber of Tepman prior to metal deposition, wherein the apparatus is capable of forming an oxide layer.

Claims 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, and Holden, and in further view of Chen et al., US 6,646,235.

Tepman does not address the means to control the wall temperature of the second chamber. In supplementation, Chen discloses the technique of circulating water through the walls of a processing chamber to control the temperature of the reaction space (6, 30-35). As Tepman intends to maintain the second processing chamber within a

specified range, it would have been obvious to one of ordinary skill to incorporate cooling passages within the wall of the second chamber to facilitate the stated objective of temperature control.

Claims 9, 10, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, and Holden as applied to claim 6, and in further view of Tsao and Beinglass et al., US 5,940,733.

The rejection below is directed only to those limitations not addressed by the rejection of claim 6:

Claims 9, 17: Tsao teaches the following:

- Positioning a substrate in a first chamber;
- The sequence of forming the following on said substrate (3, 20 – 4, 25):
  - A silicon layer (12);
  - A gate oxide layer (20);
  - A gate electrode (30);
  - A spacer (44, 46).

Tsao merely discloses the method of fabricating a schottky barrier MOSFET and is silent regarding the deposition structures which facilitate the fabrication process. Tepman, however, teaches those structural elements necessary to facilitate the method elaborated by Tsao. It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the method of MOSFET fabrication disclosed by Tsao within the apparatus of Tepman to achieve the predictable result of manufacturing a schottky barrier MOSFET.

Tsao does not address the further step of growing a silicide following the deposition of the metal film. Beinglass, disclosing a method of fabricating a polysilicon silicide composite, supplements this omission. Following the deposition of a metal layer, Beinglass transfers the substrate into another chamber for the express purpose of developing a silicide layer via heating at 500-600 degrees Celsius, as is well-known in the art (Abstract; 1, 17-39). In view of this teaching, it would have been obvious to lower the substrate from Tepman's upper portion where sputtering occurs to a lower chamber portion for the commencement of heating in order to develop a silicide.

Claim 10: Tsao applies an oxide layer which is removed and then regrown to reduce the mechanical stress of the structure (3, 37-40).

Claims 11 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, Holden, Tsao, and Beinglass, and in further view of Brabant et al., US 2003/0036268 and Chang et al., 5,043,299.

Claim 11: Tepman is silent regarding the condition of cleaning. Supplementing the omission is Chang, who discloses a method of selective tungsten deposition. Chang executes a hydrogen cleaning step (3, 20-25) wherein the pressure is maintained at 0.5 Torr (3, 41-43) and molecular hydrogen is flowed at 1 slm for 300 seconds (3, 34-35; 4, 26-30). The bake does not occur at a temperature between 700-900 degrees Celsius. Brabant, however, discloses a hydrogen bake process achieving the same end as Chang, that is, the removal of an oxide film [0102]. The reference states that a suitable temperature condition for the removal of an oxide would range from 750-900 degrees Celsius. Given this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to execute the hydrogen bake from within the range disclosed by Brabant to achieve the predictable result of removing a native oxide. It would be obvious to execute the hydrogen cleaning steps within the apparatus of Tepman to achieve the predictable result of removing wafer contaminants prior to deposition.

Claim 13: Tepman is silent regarding the thickness of the deposited metal film. In supplementation, Chang deposits a one-micron tungsten film in the presence of argon at a pressure of 200 milliTorr (5, 14-24). Provided with Chang's demonstration that these processing steps are known in the art, it would have been obvious to the skilled artisan to reproduce this method within the system of Tepman.

Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, Holden, Tsao, and Beinglass, and in further view of Aoki, US 5,242,666.

Although Beinglass performs the silicide formation at a pressure of only 500 millitorr (4, 40-45), it is well-known in the art that MOSFET formations can occur at the ultra-high vacuum conditions claimed by the applicant. For example, Aoki, disclosing a method of fabricating a MOSFET, maintains a pressure below 10^{-8} torr, thereby demonstrating the art-recognized suitability of such processing conditions (3, 40-50; 4, 26-29). It would have been obvious to one of ordinary skill in the art at the time the invention was made to employ these pressure to achieve the predictable result of MOSFET fabrication.

Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, and Holden, Tsao, and Beinglass, and in further view of Aoki and Yamoto et al., US 6,399,429.

Tsao does not address the conditions of formation of the sacrificial oxide film. Aoki, as described above, forms a MOSFET under operating conditions wherein the substrate temperature is maintained between 500-800 degrees Celsius and the pressure is below 10^{-8} torr (3, 45-50). However, the gas type and potential flow rates are not addressed. Supplementing this deficiency is Yamoto, who teaches a method of MOSFET formation. During a step of oxide formation, SiH_4 is provided at a flow rate of 9 sccm for 166 seconds, thereby demonstrating the suitability of these conditions for MOSFET formation (7, 1ff). Further, both flow rate and deposition time are result effective variables; accordingly, it would have been obvious to one of ordinary skill to execute deposition under the claimed processing conditions since it has been held that discovering the optimum value of a result effective variable involves only routine skill in art (*In re Boesch*, 617 F.2d 272, 205 USPQ 215.

Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, and Holden, and in further view of Ayers, US 6,395,093.

Tepman is silent concerning the rotary capacity of the elevating portion. In supplementation, Ayers discloses a spinner motor for use in sputtering chambers (5, 31-44). The reference attests that rotating the sample during processing improves deposition uniformity (3, 50-57). Accordingly, it would have been obvious to the skilled artisan to provide Tepman's elevating portion with rotary capabilities in order to improve the uniformity of deposition.

Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tepman in view of Moon, Bottomfield, Holden, Tsao, and Beinglass, and in further view of Ayers according to the same grounds elaborated under the rejection of claim 18.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathan K. Ford whose telephone number is 571-270-1880. The examiner can normally be reached on M-F, 8:30-5:00 EDT. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland, can be reached at 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

/N. K. F./

Examiner, Art Unit 1712

/Karla Moore/

Primary Examiner, Art Unit 1716